

C L A I M S

1. Actuator (14) for use in a microfluidic system (10), wherein said microfluidic
5 system (10) comprises a fluid network in a substrate (12) consisting of at least one
microchannel (20) arranged for transporting fluids; and an electrical connection means
(16) for application of an electric field (E) across a segment (20a) of said microchannel
(20) such that electroosmotic flow is induced in said segment (20a), characterized in that
10 said segment (20a) comprises conducting means (18), wherein a surface portion of said
conducting means (18) is curved, or inclined with respect to the electrical field (E), and
the space between the different conducting means (18), and between the conducting
means (18) and the channel walls (20b) is between $0 a_{char}$ and $2 a_{char}$, and the surface of
the conducting means is smooth, i.e. the surface irregularities are less than 5% of d_{char} ,
15 where the characteristic diameter d_{char} is the dimension of the conducting means
measured in parallel to the direction of the externally imposed electric field and the
characteristic radii a_{char} equals 0.5 times d_{char} .
2. Actuator (14) in accordance with claim 1, wherein the space between the different
conducting means (18), and between the conducting means (18) and the channel walls
20 (20b) is between $1/8 a_{char}$ and $1/2 a_{char}$, and the surface of the conducting means is
smooth, i.e. the surface irregularities are less than 1% of d_{char} .
3. Actuator (14) in accordance with claim 1, wherein the conducting means (18) has
the shape of ellipsoids, spheres, cylinders, elliptical cylinders or cones.
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4. Actuator (14) in accordance with claim 1, wherein the conducting means (18)
consist of small cylinders with the longitudinal axis normal with respect to the fluid flow
direction.

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5. Actuator (14) in accordance with claim 1, wherein the conducting means (18) has the shape of particles with planes which are inclined with respect to the imposed electric field.
- 5 6. Actuator (14) in accordance with claim 1, wherein the particles constituting the conducting means (18) have a size of 0,1 μm – 5 mm, preferable 10 μm to 500 μm , measured in parallel to the externally imposed electric field.
- 10 7. Actuator (14) in accordance with claim 1, wherein the angle λ between the inclined surface portion and the microchannel walls (20b) is 0 – 80 degrees.
8. Actuator (14) in accordance with claim 7, wherein the angle λ between the inclined surface portion and the microchannel walls (20b) is 30 – 60 degrees
- 15 9. Actuator (14) in accordance with claim 1, wherein the conducting means (18) contains several layers of conducting particles, both axially and longitudinally in relation to the flow direction.
- 20 10. Actuator (14) in accordance with claim 1, wherein the conducting means (18) consist of a ionic or electronic or hole conducting material.
11. Actuator (14) in accordance with claim 1, wherein the conducting means (18) has a conductivity of at least 5 times the conductivity of said fluid, or preferable of at lest 10
- 25 times the conductivity of said fluid.
12. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) contains a pair of electrodes arranged upstream or downstream with respect to the microchannel segment (20a).

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13. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) is adapted to provide an electrical field (E) parallel to the direction of the transported fluid.
- 5 14. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field.
- 15 15. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field which has sine, square, triangular or sawtooth shape, or a combination of said shapes.
- 10 16. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field where the signal has an offset resulting in a strong and a weak pulse within the signal period, and also a duty – cycle of preferably 29%, so that the strong pulse lasts 29% of the signal period, and where the offset and duty cycle are tuned to give a zero average direct electric signal component.
- 15 17. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field where the signal has an overloaded direct component.
- 20 18. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field where the electric signal is applied in the potentiostatic regime.
- 25 19. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field with a maximum amplitude in V/mm equal to or larger than an amplitude for which the base -10 - logarithm is in the linear interval between -2 and 2, for corresponding a_{char} [μm] for which the base -10 – logarithm is in the linear interval between 0 and 3.7.
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20. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies an alternating field with a signal period in seconds equal to or larger than a period for which the base -10 - logarithm is in the linear interval between -6 and zero, for corresponding a_{char} [μ m] for which the base -10 - logarithm is in the linear interval
5 between 0 and 3.

21. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) applies a direct electric field.

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22. Actuator (14) in accordance with claim 1, wherein the distance between each electrical connection means (16) and the conducting means (18) is between 0.1 and 5 mm.

15 23. Actuator (14) in accordance with claim 1, wherein the electrical connection means (16) contains four electrodes, two electrodes (16b) for inducing the SCR, and two electrodes (16) for setting ions in the fluid in motion (16a).

24. Actuator (14) in accordance with claim 23, wherein a first pair of electrodes (16a)
20 is arranged upstream or downstream of said segment (20a) of the microchannel (20), anywhere in the microchannel (20) or microfluidic system (10), and wherein the second pair of electrodes (16b) is positioned on each side of said segment (20b).

25. Actuator (14) in accordance with claim 23 or 24, wherein the electrical
25 connections means (16) and (16b) each applies electric fields in accordance with claims 14 - 20, where the two electric fields are out of phase.

26. Actuator (14) in accordance with claim 1, wherein the conducting means (18) is a
30 portion of the microchannel wall (20b) effecting a deflection of the local electrical field so that the field is inclined with respect to the conducting means (18).

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27. Use of an actuator (14) in accordance with one of the claims 1-26 as a micropump in a microfluidic system (10).
28. Use of an actuator (14) in accordance with one of the claims 1-26 as a mixer in a
5 microfluidic system (10).
29. Use of an actuator (14) in accordance with one of the claims 27 or 28, wherein the microfluidic system (10) is used for drug delivery.
- 10 30. Use of an actuator (14) in accordance with one of the claims 27 or 28, wherein the microfluidic system (10) is used in a "lab - on - a - chip" assembly.
31. Use of an actuator (14) in accordance with one of the claims 27 or 28, wherein the microfluidic system (10) is used for electronics cooling.

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